INDOOR AIR QUALITY ASSESSMENT

Community Action Headstart
Building One
38 Old Groveland Road
Haverhill-Bradford, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
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Background/Introduction

At the request of John Cuneo, Executive Director, Community Action Inc., an indoor air quality assessment was done at the Bradford Head Start facility in Haverhill, Massachusetts. This assessment was conducted by the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA). The request was prompted by concerns of symptoms believed to be attributed to the building.

On April 16, 2002, a visit was made to this site by Cory Holmes, Environmental Analyst, in BEHA's Emergency Response/Indoor Air Quality (ER/IAQ) Program, to conduct an indoor air quality assessment. Mr. Holmes was accompanied by Richard Lynch, Associate Director for Community Action Inc.

The Bradford Head Start facility consists of two separate, one-story wooden paneled buildings, which formally served as a day camp. Building one, which is the focus of this report, is approximately forty years old and contains two classrooms and a kitchen. Building two will be discussed in a separate report.

Methods

Air tests for carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor. Visual inspection for water damage and microbial growth were conducted throughout the building.

Results

The building is occupied five days a week by approximately 70 children daily and a staff of approximately 15. Tests were taken under normal operating conditions. Test results appear in Table 1.

Discussion

Ventilation

It can be seen from the table that carbon dioxide levels were elevated above 800 parts per million of air (ppm) in one of five areas surveyed, indicating adequate fresh air ventilation in most areas. It should be noted, however that the assessment was conducted on a day where the building was sparsely populated, which can greatly reduce carbon dioxide levels. Carbon dioxide levels would be expected to rise during periods of full occupancy.

No means of mechanical ventilation exists in the building, therefore the introduction of fresh air is solely supplied by openable windows. Some areas are equipped with window mounted air conditioners, which do have the capability of introducing fresh air in the "Fan" mode.

The Massachusetts Building Code requires a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this occurs a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week based on a time weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, please see Appendix I.

Temperature readings ranged from 66 ^{0}F to 71 ^{0}F, which were below BEHA's recommended comfort guidelines in some areas. The BEHA recommends that indoor air temperatures be maintained in a range of 70 ^{0}F to 78 ^{0}F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The relative humidity in the building was within the BEHA recommended comfort range in all areas sampled. Relative humidity measurements ranged from 48 to 50 percent. The BEHA recommends that indoor air relative humidity is comfortable in a range of 40 to 60 percent. The sensation of dryness and irritation is common in a low relative humidity environment. Low

relative humidity is a common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

BEHA staff examined the outside perimeter of the building to inspect drainage as well as for breaches in the exterior walls and roof (called building envelope), which could provide sources of water penetration.

- In a large number of areas wooden siding has become detached or completely removed from the side of the building (see Pictures 1-3).
- Beneath the wooden siding is a water barrier of tarpaper, which in some cases is damaged, and/or missing (see Pictures 2-4).
- Many areas of the building are not equipped with a gutter/downspout system. Sections of gutters/downspouts were missing parts or damaged (see Pictures 5 & 6). Incomplete or damaged gutters/downspouts can allow rainwater to run down the side of the building or pool on the ground along the foundation, dependent on wind and weather conditions. Over time, this process can allow for water penetration through the building envelope into the building.
- Also noted on the exterior of the building were missing/damaged crawlspace windows (see Picture 7). Severely water-damaged wood exists under the eaves of the roof and around window frames (see Pictures 8-10).
- Trees and other plants exist in the tarmac/exterior wall junction. In some cases ivy was growing up the exterior wall and had penetrated wooden paneling (see Picture 11). The growth of roots against the exterior walls as well as spaces between the tarmac and

exterior walls of the building can bring moisture in contact with building materials and eventually lead to breaches of the building envelope resulting in water damage and subsequent microbial growth.

Each of these conditions compromises the integrity of the building envelope and can provide a means for water penetration into the building. Repeated water damage to porous building materials (e.g., wallboard, ceiling tiles, carpeting) can result in microbial growth. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends that porous building materials be dried with fans and heating within 24 hours of becoming wet (ACGIH, 1989). If not dried within this time frame, mold growth may occur. Once mold has colonized porous materials, they are difficult to clean and should be removed.

Other Concerns

Several other conditions were noted during the assessment, which can affect indoor air quality. An unvented gas stove is located in the kitchen, which building occupants reported is heavily used. Without local exhaust ventilation, excess heat, water vapor and odors produced by cooking equipment can build up, particularly if the equipment is in frequent use. In addition, gas appliances can provide opportunities for exposure to combustion products such as carbon monoxide.

Many flying insect nests (e.g., bees, hornets, wasps) were observed around the perimeter of the building (see Pictures 12 & 13). These nests should be removed to prevent potential problems in a manner as to not introduce pesticides and/or insects into the building. Under current Massachusetts law that went into effect November 1, 2001, the principles of integrated

pest management (IPM) must be used to remove pests in schools (Mass Act, 2000). A copy of the IPM recommendations are included with this report as Appendix II (MDFA, 1996).

The administrative office had a hole in the ceiling leading to the attic that was covered with paper. This hole can provide a pathway for the movement of drafts, dusts, odors and particulate matter from the attic to move into the office. Aerosolized dust and other particulates provide a source of eye and respiratory irritation to certain individuals.

As previously mentioned, some areas contained window-mounted air conditioners. This equipment is normally equipped with filters, which should be cleaned or changed as per the manufacturer's instructions to avoid the build up and re-aerosolization of dirt, dust and particulate matter.

Conclusions/Recommendations

The conditions noted at the Bradford Community Action Head Start Facility raise several indoor air quality issues. Significant areas of the building envelope have been compromised which can lead to water damage and potential microbial growth. The combination of the design, age of the building and lack of maintenance, present conditions that can adversely influence indoor air quality. For these reasons a two-phase approach is required, consisting of **(short-term)** measures to improve air quality and **long-term** measures that will require planning and resources to adequately address overall indoor air quality concerns. In view of the findings at the time of the visit, the following **short-term** recommendations are made:

1. Use windows to introduce outside air. To supplement the use of windows consider operating window mounted air conditioners in the "fan" mode.
2. Seal hole in office ceiling.

3. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a HEPA filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).

4. Report any signs of water penetration to building owner/management for prompt remediation.

5. Replace/repair crawlspace windows to prevent water penetration.

6. Consider providing local exhaust ventilation for the gas stove.

7. Change filters in window-mounted air conditioners as per the manufacturer's instructions to prevent the re-aerosolization of dirt, dust and particulate matter.

8. Remove plant growths against the exterior wall/foundation of the building to prevent water penetration.

9. Use integrated pest management (IPM) to remove pests from the building. A copy of the IPM recommendations is included with this report as Appendix II (MDFA, 1996). Activities that can be used to eliminate pest infestation may include the following activities.

    i) Consult a licensed pesticide applicator on the most appropriate method to end infestation.

    ii) Reduction/elimination of pathways (e.g., spaces under doors)/food sources that are attracting pests.

iii) Reduce harborages (plants/cardboard boxes) where pests may reside.

The following **long-term** measures should be considered.

1. Examine the feasibility of installing a gutter/downspout system to parts of the building without them. Repair/replace existing gutters and downspouts that are damaged/missing.
2. Consult with architect and or general contractor regarding water tightness of the building primarily concerning the condition of siding and window frames. Have consultant assess water damaged building materials (e.g., eaves, ceilings, building envelope).
3. Replace/repair missing siding/shingles.

References

ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

BOCA. 1993. The BOCA National Mechanical Code/1993. 8th ed. Building Officials & Code Administrators International, Inc., Country Club Hills, IL.

Mass. Act. 2000. An Act Protecting Children and families from Harmful Pesticides. 2000 Mass Acts c. 85 sec. 6E.

MDFA. 1996. Integrated Pest Management Kit for Building Managers. Massachusetts Department of Food and Agriculture, Pesticide Bureau, Boston, MA.

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R 1910.1000 Table Z-1-A.

SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0

Picture 1

Detached Wooden Siding

Picture 2

Missing Siding Panel Exposing Tar Paper Barrier

Picture 3

Detached Wooden Siding

Picture 4

Missing Siding/Breaches in Tarpaper Water Barrier

Picture 5

Missing/Damaged Downspout

Picture 6

Damaged Gutter System Note Spaces at Joint and Debris inside Gutter

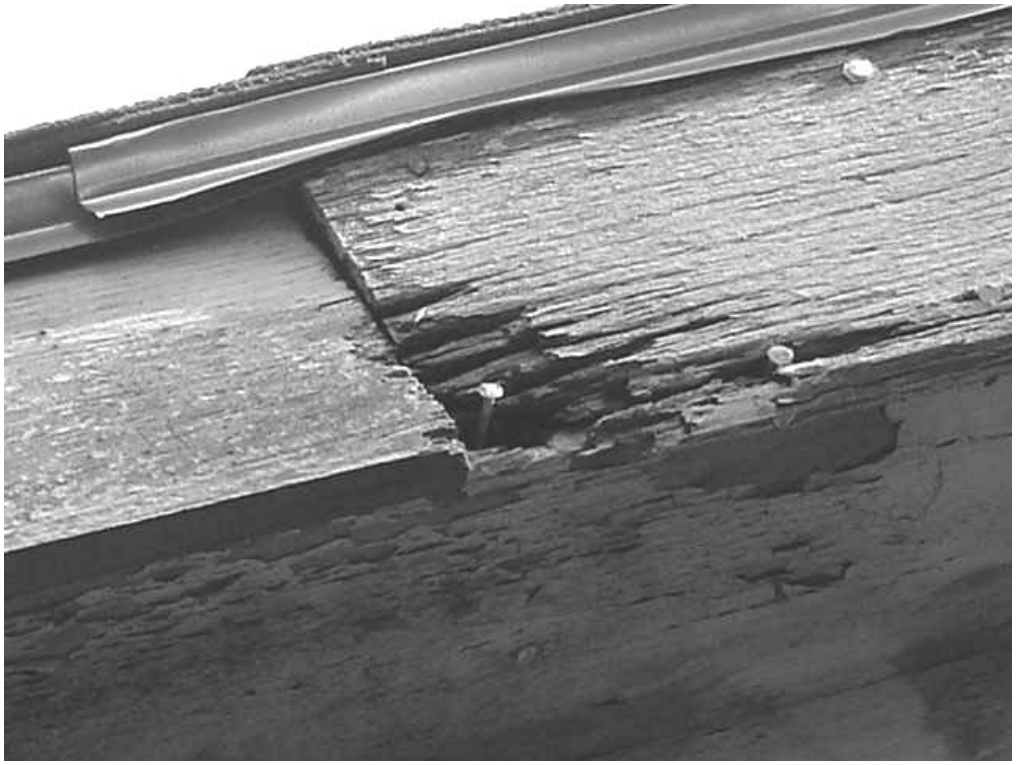
Picture 7

Broken Crawlspace Window

Picture 8

Wood Rot Roof Eve

Picture 9



Wood Rot Roof Eve

Picture 10

Rotted Wooden Windowsill Note Screws of Windowframe are Exposed

Picture 11

Ivy Growth beneath Wooden Siding

Picture 12

Large Hornets/Wasp's Nest beneath Roof Eve

Picture 13

Bees Nest beneath Detached Wooden Siding

TABLE 1

Indoor Air Test Results –Haverhill, Bradford Community Action Headstart Facility, Building One
April 16, 2002

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Outside (Background)	412	63	60					Weather conditions: Overcast, light breeze
Perimeter Notes								Bees/Wasp's nests, missing damaged siding, tar paper-holes/ripped/torn, window frame/eaves rot, broken/missing crawlspace windows, trees/vegetation against building/foundation, rotted/damaged stairwell, missing damaged gutters/downspouts
Right Classroom	683	66	50	2	Y	N	N	
Office	833	66	50	2	Y	N	N	Hole in ceiling covered with paper (stapled to ceiling)
Left Classroom	720	71	48	0	Y	N	N	Window AC
Kitchen	650	72	49	0	Y	N	N	Gas stove-no local exhaust ventilation (main cooking site ~ 140 kids)

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%